United States Department of Agriculture
Forest Service
Umatilla National Forest
2517 S.W. Hailey Ave.
Pendleton, OR 97801

CHA 1-1

Reply to: 3420
2470

Date: January 24, 1990

Subject: Stump Treatment for Annosus Root Disease

To: District Rangers - Heppner, North Fork, Pomeroy, Walla Walla

Attached are the one year results of a study conducted by Greg Filip, Craig Schmitt, and Kevin Hosman of the LaGrande Lab on the effects harvest season and stump size on the incidence of Annosus root disease in grand fir stumps. The study was done on the Walla Walla R.D., so it has direct applicability on our method of managing grand fir stands. The results are very clear and have strong implications. Annosus root disease was present in almost 90% of the grand fir stumps examined 5-10 years after harvest. Mortality of regeneration surrounding the infected stumps was currently low (1%), but can be expected to greatly increase as seedling root systems and the Annosus in infected stumps expand. Observations on the Fremont and Ochoco Forests indicate infection rates of around 20% after 30 years, and increasing. The study was conducted primarily in the grand fir/big huckleberry plant community, but similar results can be expected in other communities having grand fir as a component. Greg Filip has cautioned us that he suspects similar results would be found with subalpine fir, and plans are under way to implement a similar study with this species.

Given these preliminary results, it is clear that we cannot expect grand fir regeneration to be manageable in a stand unless harvested grand fir stumps are treated with borax immediately after cutting. Borax treatment of grand fir stumps prevents the stump surface from being infected by Annosus spores, which spread through wind transport, unlike the other major root rots we experience which primarily spread by root to root contact. To implement the borax stump treatment, we have timber sale contract optional clause C6.412, option 2, Treatment of Stumps. It is currently being used extensively on the Walla Walla R.D. with success.

It is my direction that in stands where for one reason or another grand fir will be a significant (>20%) portion of our managed stand, that stumps from current harvest be treated with borax to minimize the infection levels of Annosus root disease in the post harvest stand. This direction will be especially important in shelterwood units with grand fir leave trees, and in group selection or single tree selection units in grand fir habitat types.

If you have any questions on this direction, please contact Rob Mrowka for advise and consultation.

James A. Lawrence
JAMES A. LAWRENCE
Forest Supervisor

MESSAGE SCAN

To J.BEATTY:R06A
CC D.GOHEEN:R06A
CC E.GOHEEN:R06A
CC P.HESSBURG:R06A

From: GREGORY M. FILIP:S26L06A
Postmark: Jan 17,90 2:18 PM Delivered: Jan 17,90 2:46 PM
Status: Previously read
Subject: ANNOSUS STUMP SURVEY RESULTS

Comments:
Here are the results of a study we did this summer. We would appreciate any comments.

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OFFICE REPORT

EFFECTS OF HARVESTING SEASON AND STUMP SIZE ON INCIDENCE OF *FOMES ANNOSUS* IN GRAND FIR STUMPS IN NORTHEASTERN OREGON: FIRST YEAR RESULTS

Gregory M. Filip, Craig L. Schmitt, and Kevin P. Hosman

ABSTRACT

Ten seed tree/shelterwood harvest units on the Walla Walla Ranger District were examined for the presence of *Heterobasidion annosum* (=*Fomes annosus*) in stumps of grand fir (*Abies grandis*) cut 5 to 10 years previously. 89% of the stumps were found to be infected with an average of 51% of the wood decayed by *H. annosum*. There was no significant difference in the incidence of infection or amount of stump wood decayed among seasons of harvesting or stump size classes. Mortality caused by *H. annosum* of grand fir regeneration surrounding infected stumps was less than 1% of the total stems/acre. Sampling *H. annosum* by the traditional method of incubating stump disks is not recommended for grand fir in northeastern Oregon. We recommend treating freshly cut stump surfaces with borax to prevent infection in similar stands.

INTRODUCTION

Root disease caused by *Heterobasidion annosum* (=*Fomes annosus*) is one of several important root diseases causing damage in the interior West (Filip and Goheen 1984, Hadfield and others 1986, Hagle and Goheen 1988). Despite observations by forest pathologists in Oregon, Washington, Idaho, and Montana that indicate a widespread and growing presence of annosus root disease in grand fir (*Abies grandis*) and Douglas-fir (*Pseudotsuga menziesii* var. *glauca*) ecosystems, almost no research has been conducted on incidence and severity of

annosus root disease in relation to stand and site factors. High elevation grand fir stands are being harvested with increasing frequency in northeastern Oregon. These stands often regenerate, by design or otherwise, to grand fir. The grand fir/big huckleberry plant association (Hall 1973) can be successfully managed by shelterwood or seed tree regeneration methods if forest pests are controlled. Such prescriptions are common in northern Blue Mountain grand fir stands. Stumps from harvested true firs can serve as foci to infect surrounding advance grand fir regeneration. Adequate measures to prevent stump infection of true firs with borax have been demonstrated (Smith 1970), but information is needed in northeastern Oregon as to the types of stands and stumps that become infected.

A few reports exist on the incidence of *H. annosum* in eastern Oregon true fir stands. In one survey on the Fremont and Ochoco National Forests in southern Oregon, Schmitt and others (1984) found that the greatest amount of mortality was found in true fir stands that had multiple harvest entries, and most of the damage was caused by *H. annosum* with and without fir engraver beetles (*Scolytus ventralis*). In a 1986-1987 survey on the Wallowa-Whitman National Forest, a substantial portion of the mortality was also found associated with *H. annosum* (Schmitt, in preparation). In one grand fir stand precommercially thinned 14 years previously in northeastern Oregon, 29% of the stumps were infected by *H. annosum* (Filip, unpublished).

Stump size appears to be an important factor that determines the success of stump infection and subsequent spread of *H. annosum* to surrounding regeneration. Stumps of ponderosa pine (*Pinus ponderosa*) less than 6 inches in diameter do not serve as adequate hosts because of lethal temperatures that occur in the summer in California (Smith, unpublished). Even if infected, small stumps do not appear to be able to serve as foci for infection of

surrounding trees. Some data supports this observation in northeastern Oregon true fir stumps where, after 14 years, none of the dead crop trees were infected by _H. annosum_ even though 29% of the thinning stumps (diameter range 2-8 inches) were infected (Filip, unpublished). Schmitt and others (1984) report that "virtually all stumps that served as infection foci were 18 inches or greater in diameter" on the Fremont and Ochoco National Forests. Incidence of infection in various size stumps is required to properly address and develop control strategies.

Season of harvesting is another important factor that may affect success of stump infection. In a study in eastern Washington with ponderosa pine, stumps were created every month for two years. Stumps were sampled 4 months after cutting to determine if month of cutting affected success of infection of _H. annosum_ (Russell and others 1973). Stump infection was greatest when stumps were created during rainy periods in the fall. Land managers need to know in what seasons unacceptable levels of stump infection can occur. Borax stump treatment, which prevents _H. annosum_ infection, can be specified as a contract requirement in Forest Service timber sales.

The primary objective of this study was to relate the severity (percentage of stump wood decayed) of _H. annosum_ to season of harvesting and stump size in 10 grand fir stands in northeastern Oregon. Specifically we tested for differences in _H. annosum_ among 3 harvesting seasons, 3 stump size strata, and 3 stump size strata within harvest seasons (interaction between stump size and season). A secondary objective was to determine the incidence of mortality in conifer regeneration adjacent to infected stumps. These results should be applicable to grand fir stands on the Umatilla National Forest.

METHODS

Stand Selection

Ten harvest units in stands of grand fir (grand fir and subalpine fir plant community series, Hall 1973) were selected on the Walla Walla Ranger District, Umatilla National Forest with the help of the Forest Inventory Data Base, Timber Sale records, and local forest managers. These stands were harvested (shelterwood or seed-tree cuts) 5 to 10 years ago. This 5-year period minimized the variability in "years since cutting" which has been shown to be correlated with H. annosum incidence (Morrison and Johnson 1978, Shaw 1981).

Trees that were colonized by H. annosum before harvesting (those infected through butt wounds or root contacts) were descriminated against by not sampling stumps with hollows. Some trees with prior infections, however, were probably included in the sample, because there was no absolute way to distinguish between stump infection before and after cutting. This is not a serious problem, because all units sampled, regardless of season of cutting, should have an equal proportion of stumps with prior infections. Also, all sizes of trees (stumps, 12 to 24+ in. dia.) should have an equal probability of prior infection. Therefore, any significant differences in incidence and severity of infection among treatments should be the result of any additional infection that occurs after tree harvesting. Infection of living grand fir by H. annosum has been shown to be about 2% of the trees throughout Oregon and Washington (Aho and others 1987). Also, prior infection in the stand probably was low because most sampled stands had been only harvested once 5 to 10 years ago.

The month that each unit was harvested was determined from timber sale records and classified as (1) November-May, (2) June-August, or (3) September-October. We originally planned to sample an equal number of units from each season. However, most units were harvested in the summer, and very

few in the fall and winter. We randomly selected five units harvested in the summer. We sampled two units harvested in the fall and three units in the winter. These five units represented all of the available units harvested during fall and winter on the District given our other restrictions.

The following information was obtained, both through the data base and in the field, for each stand: (1) years since harvesting, (2) plant community, (3) aspect, (4) % slope, and (5) elevation.

Stump Sampling

A preliminary sample of stumps showed that the traditional method of detecting H. annosum in stumps by incubating disks cut from stumps (Morrison and Johnson 1978, Morrison et al. 1986, Russel et al. 1973, Shaw 1981) is not effective for grand fir in northeastern Oregon. Incubation of 90 disks cut from stumps with H. annosum detected by root excavations revealed no sporulation of the imperfect stage (Spiniger meineckellus) of H. annosum. Isolation of wood chips from all disks onto selective media (2% malt agar and 1, 5, or 10 ppm benomyl added after autoclaving) also failed to recover H. annosum even from disks with typical decay. Also, many stumps with H. annosum decay below the groundline did not have typical H. annosum decay in the disk or other types of decay were present in the stump disk. H. annosum was frequently isolated from typical decay below the groundline.

We speculate that after being cut for 5 to 10 years, the above-ground portion of stumps dessicate to the point where H. annosum is no longer viable. Apparently the below-ground portion of the stump is cool and moist enough for the fungus to remain viable.

When possible, at least ten stumps were randomly selected from all stumps stratified by three diameter classes: 12 to 18 in., 19 to 24 in., and 24+ in.,

for a total of 30 stumps per unit. In some cases, there were not enough stumps within a size class in which case, stumps of other size classes were sampled instead to obtain 30 stumps per unit.

The percentage (nearest 10%) of stump wood decayed by H. annosum was occularly estimated in the field by dissecting the stump below the root collar on at least four sides with a pulaski and observing the typical laminated decay caused by H. annosum. Samples of wood (3x3x3 in.) with typical laminated decay were placed in a plastic bag with a numbered tag, transported to the laboratory, and refrigerated until processing within 48 hours.

Stump Culturing

In the laboratory, each stump sample was cultured for the imperfect stage of H. annosum as follows. Each 3x3x3 in sample was soaked in 20% chlorox solution for one minute. Each sample was dissected asceptically with a hatchet. Ten wood chips (10x2x2mm) were removed with a wood gouge and placed on selective media (2% malt agar with 1, 5, or 10 ppm benomyl added after autoclaving), 5 chips per petri plate. Plates were incubated 5 to 7 days in the dark at room temperature.

Mortality Plots

Within each of the 30 stands, permanent plots (1/25 acre) were established around each of the 30 stumps to monitor the incidence of mortality in regeneration caused by H. annosum. Each sampled stump served as the plot center. Plots were sketch mapped in relation to one another. Each stump was marked with a two-foot section of rebar (one-foot buried into the center of the stump) with a numbered aluminum tag affixed to the rebar with wire. All seedlings ($\geq$ 6 inches in height), saplings, and poles ($\leq$ 6 in. DBH) including

dead trees within 23.6 feet (1/25 acre plot) of the plot center (stump) were identified by species, condition (live or dead), and cause of mortality. Tree mortality was identified as to cause by culturing as described above. Distance of all dead stems to the plot center was also recorded.

Data Analysis

Analysis of variance was used to determine significant ($p \leq 0.05$) differences in the mean percentage of stump wood with decay caused by _H. annosum_ among harvesting season and stump size classes. A split-plot design was used as follows:

Source		df
Whole plot analysis		
Harvesting season	a=3	a-1=2
Error A	r=3	a(r-1)=4
Split-plot analysis		
Stump size class	b=3	b-1=2
H x S interaction		(a-1)(b-1) =4
Error B		a(b-1)(r-1)=12
Total		abr-1=26

Significant differences among treatments were tested further using Fisher's least significant difference test.

RESULTS

In the summer of 1989, 300 stumps were examined in 10 harvest units on the Walla Walla RD. All but one unit was a grand fir/big huckleberry plant community (Table 1). Of the 300 stumps sampled in all units, 89% were decayed

by _H_. _annosum_ (Table 2). The percentage of wood decayed among all stumps was 51%. There were no significant differences in percentage of wood decayed among the three harvesting seasons or among the three stump size classes. Many of the stumps were also infected by _Armillaria_ spp.; species identifications were not attempted.

Regeneration around sampled stumps was generally heavy (mean of 1534 stems/acre) but unevenly distributed. Most of the regeneration was grand fir (52%) with lesser amounts of Douglas-fir (14%), Engelmann spruce (_Picea engelmannii_ (15%), and western larch (_Larix occidentalis_) (12%) (Table 2). Douglas-fir, larch, and spruce are seldom damaged by annosus root disease (Hadfield and others 1986). Minor amounts of subalpine fir (_A_. _lasiocarpa_), ponderosa pine, lodgepole pine (_P_. _contorta_), western white pine (_P_. _monticola_), and Pacific yew (_Taxus brevifolia_) were also recorded. Regeneration was mostly seedlings and small saplings, but some pole-size residuals were also recorded.

Regeneration mortality by all causes was insignificant and ranged from 0.5 to 5.5% of the total stems/acre (Table 1). Most of the mortality was mechanical damage or weather related. Some mortality was caused by _Armillaria_ spp. Less than 1% of the total stems/acre were killed by _H_. _annosum_, and all of this was grand fir.

CONCLUSIONS AND RECOMMENDATIONS

1. We found a very high frequency (89%) of annosus root disease in grand fir stumps cut 5 to 10 years ago in seed tree/shelterwood units in northeastern Oregon.

2. Season of harvesting did not affect incidence or amount of decay caused by *H. annosum*.

3. Stump size (12 to 24+ in.) did not affect incidence or amount of decay caused by *H. annosum*.

4. Detection of *H. annosum* using disks removed from the base of stumps is not appropriate in grand fir stumps cut 5 to 10 years ago in northeastern Oregon.

5. Mortality caused by *H. annosum* of regeneration surrounding infected stumps is insignificant at this time.

6. Some units are well stocked with conifer species that are seldom damaged by annosus rot disease (Douglas-fir, larch, spruce).

7. Plots are being monitored for mortality in regeneration surrounding infected stumps. New plots with stumps treated with borax may be established.

8. At this time, we recommend that stands in similar plant communities that are scheduled to have seed tree or shelterwood cuts have stumps treated with borax immediately after cutting, especially stands without adequate regeneration of Douglas-fir, larch, or spruce. Seed or shelterwood trees should also be treated when they are subsequently harvested. Borax treatment should prevent *H. annosum* infection of freshly cut stumps and reduce possible future mortality of surrounding susceptible regeneration.

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Table 1. Characteristics of ten shelterwood/seed tree harvest units sampled for annosus root disease (HA) on the Walla Walla Ranger District, northeastern Oregon

Unit Name	Legal Descr.	Elev.	Aspect	Slope	Plant Com.	Stumps With HA	Total Regen. Mort.
		(ft)		(%)		(%)	(%T/A)
			Summer Harvest				
Target 456	T4N R38E,S20	4900	E	25	ABLA VAME	90	2.8
Cross Canyon #35	T6N R41E,S25	3800	N	10	ABGR-VAME	47	0.8
Lower Mottet #7	T3N R39E,S3	3600	NE	15	ABGR VAME	100	1.1
Lower Mottet #9	T3N R39E,S3	3700	NE	15	ABGR VAME	100	0.8
Fry Ck.#35	T3N R40E,S4	3800	NE	5	ABGR VAME	97	3.9
			Fall Harvest				
Cross Canyon #48	T6N R41E,S26	4200	E	20	ABGR VAME	90	1.2
Lookingglass #24	T4N R39E,S13	4300	SW/NE	45	ABGR VAME	90	0.7
			Winter Harvest				
Lookingglass #11	T4N R39E,S24	4200	E	25	ABGR VAME	100	2.0
Lookingglass #16	T4N R39E,S24	4200	NW	10	ABGR VAME	100	0.5
Lookingglass	T4N	4100	NW	10	ABGR	77	5.5

#17 R39E,S24 VAME

[1]ABLA-VAME= Subalpine fir/big huckleberry; ABGR-VAME= Grand fir/ big huckleberry

Table 2. Characteristics of 300 grand fir stumps cut 5 to 10 years ago and sampled for annosus root disease (HA) on the Walla Walla Ranger District, Northeastern Oregon.

Mort. sed by	Stump Dia. Class (in.)	No. of Stumps	Stump Age (yrs.)	Stumps With HA (%)	Stump Wood Decayed (%)	Total Stocking (T/A)	Conifer Species[1] GF	DF	ES	WL	SF	OT	GF Cau HA
							percent						
	12-17	22	148	90	65	1650	48	17	23	4	0	8	<1
Fall Harvest	18-23	17	180	83	59	1069	58	15	9	7	0	11	<1
(Sept.-Oct.)	>23	21	246	100	51	1205	53	14	17	3	0	13	<1
2 units	all	60	192	90	61	1330	51	16	18	5	0	10	<1
	12-17	34	112	97	54	1391	58	7	14	4	15	2	<1
WinterHarvest	18-22	29	127	90	48	1180	55	10	17	3	14	1	0
(Nov.-May)	>23	27	141	82	43	701	44	10	32	8	4	2	0
3 units	all	90	126	92	49	1119	54	8	19	4	13	2	<1
	12-17	65	108	88	56	1709	56	17	9	15	1	2	<1
SummerHarvest	18-23	58	121	85	45	2024	47	17	13	19	<1	4	<1
(June-Aug)	>23	27	161	89	43	1818	52	14	16	15	1	2	<1
5 units	all	150	126	87	48	1851	52	16	12	17	<1	3	<1
	12-17	121	116	91	57	1609	55	15	13	10	4	3	<1
All Seasons	18-22	104	132	86	48	1632	51	15	13	14	3	4	<1
10 units	>23	75	178	90	45	1274	51	13	20	10	1	3	<1
	all	300	139	89	51	1534	52	14	15	12	3	4	<1

[1] GF= Grand fir; DF= Douglas fir; ES= Engelmann spruce; WL= Western larch; SF= Subalpine fir; OT= Other species (ponderosa pine, white pine, lodgepole pine, pacific yew)